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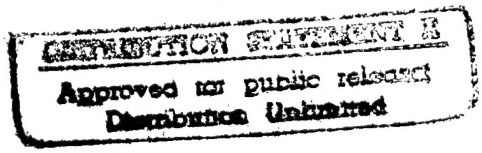

# The Test Environment Challenge

The 21st century tester faces the challenge of generating natural and manmade environments that represent conditions under which new weapon systems must operate.

Natural environments include weather, terrain, and natural electromagnetic (EM) conditions which traditionally have been individually tested in climatic chambers and lightning facilities. "Manmade" environments are conditions generally created by the military forces to disrupt the enemy, ranging from chemical, biological, and nuclear agents which kill or incapacitate, to electronic countermeasures and obscurants which distract or confuse its weapons (or ours).

We project that the 21st century arsenal (both ours and theirs) will include new environments such as low energy lasers, non-nuclear EM pulse, infrasound, calmative agents, and visual simulation/illusions. Since a large part of the motivation and design of 21st century military equipment is driven by these environments, we must be able to produce those conditions.

"Test environments" also include nontraditional environmental protection compliance, a recently emphasized test concern. We must comply with Federal and state laws regarding the natural environment, and testers may be held accountable and liable. Testers must consider the effects of weapons testing upon the environment as well as the effects of the environment upon weapons.

The Distributed Interactive Simulation (DIS) system and the Digitized Battlefield (DB) are unique, nontraditional test environments, and are themselves systems to be tested and evaluated. They also are "test beds" for test and evaluation (T&E) of a wide range of systems, subsystems, and components. Nonlethal (NL) testing is included to emphasize the need for realistic (T&E) of weapons particularly useful in operations other than war. Finally, human engineering, ergonomics, is included because of the impact of the man-machine interface at all levels.

Environmental challenges confronting 21st century testers are electromagnetic, climatic, nuclear biological Chemical (NBC) testing, and environmental compliance (EC).

## Electromagnetic Test Challenges

Perhaps the most formidable challenge to testers is creation of *Electromagnetic Test Environments*. The 21st century Army will be organized around information to permit flexibility and

versatility, with weapons linked electronically to allow a commander to synchronize all elements of the battlefield. Wargaming planning, training, and (T&E) will be accomplished in a synthetic environment within which humans interact through a systematic connection of subcomponent simulations, simulators, and instrumented live forces. Components may reside at multiple and distant locations, tied together through standard communications. Command, control, and communications (C3) will be exercised in the domain of the EM spectrum. Potentially, any training, receiving, sensing, or tracking device that uses EM signals could be interrupted or subject to EM interference (EMI). International interference - electronic warfare (EW) - is probable in a warfighting situation.

EM test environments may be open air and closed. Either may be linked with other facilities such as the Air Force Electronic Warfare Evaluation Simulator, the Real-Time Digitally Controlled Analyzer Processor, the EM Test Environment, and the Preflight Integration of Munitions and Electronic systems. (T&E) may be completed through the use of models and simulations, hardware-in-the-loop testing, and field testing.

Outdoor sites for testing systems operating within the EM spectrum vary from compact, specialty ranges to naturally quiet EM environments spanning thousands of miles of land, sea, and air space.

Frequencies covered during testing range from mid-Hertz to ultraviolet. Any device, system, subsystem, or component that emits EM signals or is subject to influence by EM emissions is a candidate for testing. These include voice and data transmitters and receivers in all frequency bands, radars, laser range finders and designators, electro-optical and infrared thermal systems, single-and multi-spectral sensors, EW systems, and equipment vulnerable to EMI or to be tested for EM compatibility/EM vulnerability (EMC/EMV).

A major challenge for Force XXI (T&E) will be testing elements of the foregoing used in concert as a "system of systems," which is the essence of DIS and DB. In this context, the "open air" EM test environment expands to include the full geographical extent of the DIS and DB.

Indoor EM test facilities consist of anechoic and other shielded chambers, ranging in size from those capable of testing manpack and tracked-vehicle systems to those capable of testing for technical characteristics and performance, EMI, EMC, EMV, EW, and security.

Typical of the new items which must be tested in the EM environment are unmanned aerial vehicle sensors, electronic intelligence receivers, neural networks, extremely high frequency (20-44GHZ) commo, battlezone power systems, acoustic sensors, fiber optics, high-power microwave weapons, and anti-sensor

lasers.

## Climatic Test Challenges

Environmental climatic testing is required for all current and future system and platform developments. Specific environmental conditions are well defined - pressure, turbulence, temperature extremes, altitude variations, moisture and precipitation in various forms, soil in various forms, solar radiation, wind, fungus of various forms, ocean tides, salt and sea spray, noise, and toxic gases.

The climatic test environment is the total meteorological, geological, biological, oceanographic, and astronomical setting within which tests are conducted. Each open-air test facility or range has natural meteorological and geographical characteristics that provide specific test conditions, usually part of the reason for selection of a test site location. Indoor climatic test environments may be controlled for precise reproduction of desired conditions.

Chambers of various sizes and capabilities have been used in the test community for years. Our challenge is to create the synergistic effects of several climatic conditions and to isolate causes of test-item problems under multiple stresses.

## NBC Test Environments

Despite an international mood to reduce or eliminate NBC weapons, many nations, including "third-world" countries, still have them. Our Army must be prepared to perform in the environments created by these weapons. The tester must continue to pursue technologies to simulate the environment and assess performance under the appropriate conditions.

The nuclear weapons effects that are T&E areas of interest include blast and shock, thermal radiation, EM pulse (EMP), X-ray, neutron radiation, gamma dose rate, gamma dose, and secondary effects resulting from interaction of these effects. Only chemical/biological defense is addressed, assuming agreement to the bilateral/multilateral Chemical Warfare Convention will preclude chemical and biological (T&E) for offensive warfare. Dedicated chemical warfare (CW) and chemical biological detection (CBD) (T&E) capabilities for DOD reside only at U.S. Army Dugway Proving Ground, Utah. The U.S. Army Test and Evaluation Command (TECOM) is the Army's single point of contact for CW/CBD, and reviews all CW/CBD (T&E) requirements for the four services. Foreign governments, and private industry.

Chemical facilities intended solely for research and development are located at the Edgewood Research, Development and Engineering Center (ERDEC), Aberdeen Proving Ground, MD.

Discussion of creating testing conditions for the 21st century Army must include the environment of the DB. Today's Army depends on modern, robust communications and computer systems at each battlefield operating system. The DB concept uses state-of-the-art C3 to achieve control of the battle space, operational tempo, and environment.

Resultant capabilities are battlefield synchronization, joint precision strike operations, a near realtime common battlefield picture, point of engagement identification, and situational awareness at the lowest level. (T&E) of the sophisticated, complicated DB requires detailed planning, identification of test requirements and goals, and careful test process development. Once the DB process is achieved, it may be adapted as a (T&E) test bed for new systems, subsystems, and components.

The testing technology necessary to create the DB environment is DIS, the creation of a synthetic environment within which humans and simulations interact at multiple networked sites using compliant, open architecture, modeling, protocols, standards, and data bases. Sophisticated integration of simulations and information resources across functional domains permit unencumbered information sharing, generate knowledge, and enhance innovation for systematically improving military capabilities. This allows participants at diverse sites to interact simultaneously through simulators, simulations, and deployed systems in a common joint synthetic operational environment.

The DIS is a "system of systems" incorporating new and emerging technologies. DIS testing is an invaluable test-bed asset to provide extraordinarily realistic test environments, add variety and scale to the test environment, and provide T&E in areas which are unsafe or which are not economically or logistically feasible.

21st century testers must be alert to *NL Testing*. Nonlethal devices and disabling technologies will be part of the 21st century Army arsenal. U.S. Army tasks range from engagement in major regional conflicts to lesser engagements, including civil authority support, counter-drug operations, combating terrorism, security assistance, peacekeeping operations, attacks and raids, and show of force. In each scenario, NL technologies may accomplish objectives without injury or loss of life, including low-energy laser weapons, isotropic radiators, nonclear EMP, high-power microwave, infrasound, liquid metal embrittlement, supercaustics, anti-traction technology, polymer agents, combustion alteration technology, calmative agents, and visual simulation and allusions. Many NL technologies and devices could be adapted from civilian use. Those that are specifically military may require Army sponsorship. In any case, appropriate T&E will be required to determine the exact nature and employment parameters of nonlethal weapon test items. The test technology planner must consider whether the NL test

environment needs consider facilities required to conduct nonlethal technologies (T&E) the unique communication requirements associated with operations other than war; and the new (T&E) planning processes needed.

**Environmental Compliance**

A "last but not least" challenge to 21st century testers is the widely publicized area of *environmental compliance*, mandatory in the planning and conduct of weapon systems (T&E). The plethora of Federal, state, and local environmental protection regulations indicates intense public interest. New and evolving technologies are challenging capabilities of test assets to provide realistic test environments, which also face encroachment from outside developments. Test environments often contain unique and sensitive environmental resources.

Liabilities associated with noncompliance with environmental protection regulations can be severe, including personal criminal penalties. Environmental compliance needs should be an integral part of (T&E) planning and execution.

Compliance issues include pretesting baseline environment status evaluation, environmental impact assessment, and Environmental Impact Statement if required; informing citizens of plans, identifying key local figures, and gaining their support; ensuring compliance with Federal, state, and local environmental protection laws, and that waivers and reliefs are obtained; post-test site restoration requirements and plans; understanding legal liabilities of testers and test support agencies; source characterization models that define the acoustic, EM and toxin particulate loads created by test activities; remediation to clean up old/used test sites; and bioremediation.